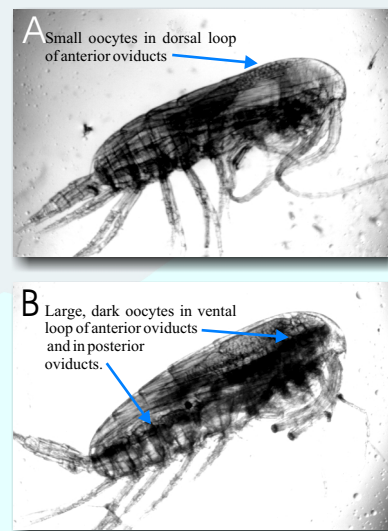


Springtime Distribution and Gonadal Maturity of *Calanus marshallae* over the Southeastern Bering Sea Shelf

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Figure 1. *Calanus marshallae* is a dominant springtime zooplankton over the southeastern Bering Sea Shelf. Its early stages are preferred prey for young walleye pollock, an important food species for higher trophic levels, including humans. Therefore, the magnitude and timing of production by *C. marshallae* may strongly affect the Bering Sea ecosystem and commercial fisheries. We quantified *C. marshallae* copepodites from 333- and 153- μ m mesh bongo samples, and used criteria modified from Runge (1987) to distinguish females in early (A) and late (B) stages of gonadal maturity. Females in later stages of gonadal maturity are assumed to be ready for fertilization and release of eggs.



Photos by Morgan Busby & Chris Baier

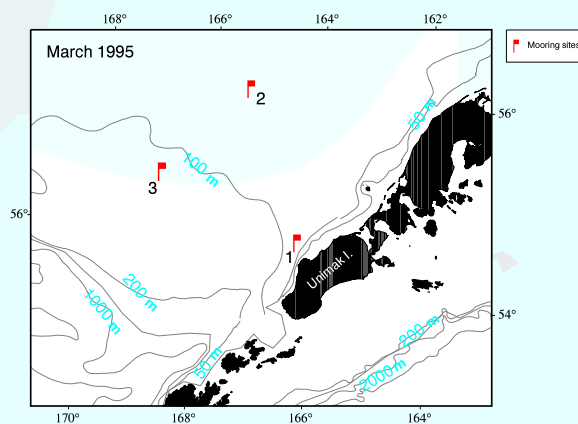
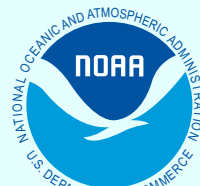
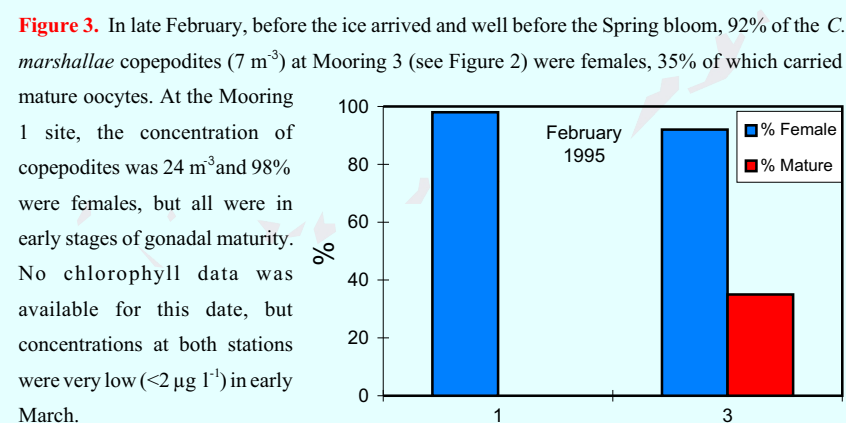


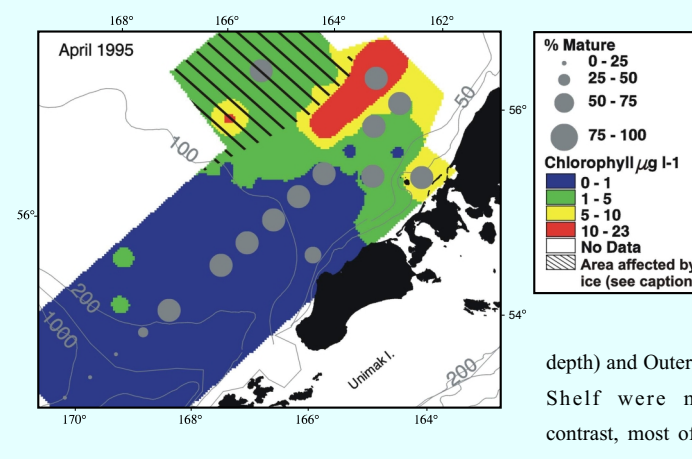
Figure 2. Collections were made over the southeastern Bering Sea Shelf during the Spring of 1995, a year of unusually extensive sea ice (blue). *C. marshallae* copepodites were collected during late February, before the ice arrived (March), and in late April, shortly after the ice retreated. Chlorophyll Absorbance Meters (ChlAM) at Moorings 2 & 3 recorded an increase in chlorophyll when ice covered the sites, beginning a bloom which peaked in late April. Beyond the range of the sea-ice at Mooring 1, chlorophyll concentrations did not increase until mid-May. Redrawn from Stabeno *et al.* (1998).

Conclusions

- Maximum egg production by *Calanus marshallae* has been thought to depend on high concentrations of large diatoms associated with the Spring bloom. During this study, however, females reached gonadal maturity well before the bloom and also occurred in areas of very low local concentrations of phytoplankton. Early copepodites constituted a significant proportion of the population in April, indicating that a cohort was produced under the ice and well before the Spring bloom. Egg production may have been fueled by omnivory, lipid stores, or both.
- By February 1995, nearly all sampled copepodites had undergone the terminal molt to C6 (adult), and females were the predominant stage in April. These results support Peterson's (1988) speculation that *C. marshallae* may compensate for low daily egg production by producing over a long female lifespan.
- Egg production by *C. marshallae* has been observed over the Bering Sea Shelf as late as July (Flint 1994). Were these females from the overwintering generation or were they the progeny of the overwintering generation?
- We observed differences in population density, stage composition, female size, and gonadal maturity among the Slope and Shelf Domains. This suggests that different populations may be associated with the Shelf and Slope Domains.



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over the Slope ($>200 \text{ m}$) were in early stages of oogenesis. Densities of females were very low over the Slope ($<2 \text{ m}^{-3}$), increasing landward across the Outer Shelf to as many as 350 m^{-3} over the Middle Shelf. The gonadal maturity of females differed among the Domains (Kolmogorov-Smirnov test, $P < 0.01$), but showed no relationship to sea-surface chlorophyll concentration (sampled at 27-km intervals on a rectangular grid). In the northern Middle Domain (hashed area), where the bloom had already peaked and begun to sink, subsurface chlorophyll concentrations were high and surface values did not represent available food.

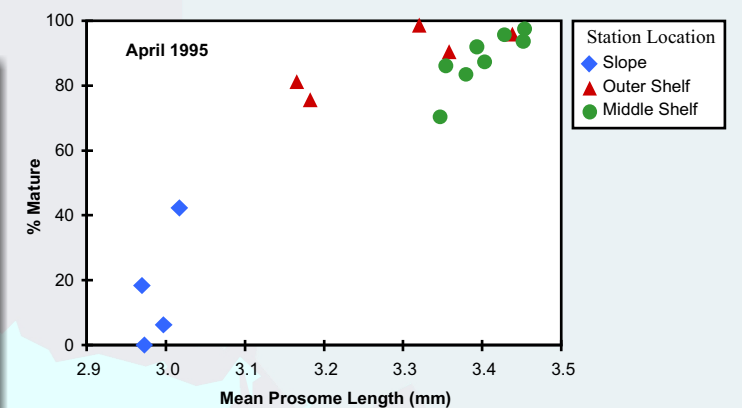


Figure 6. Gonadal maturity showed a positive relationship to female size, and both increased from the Slope to the Middle Shelf.

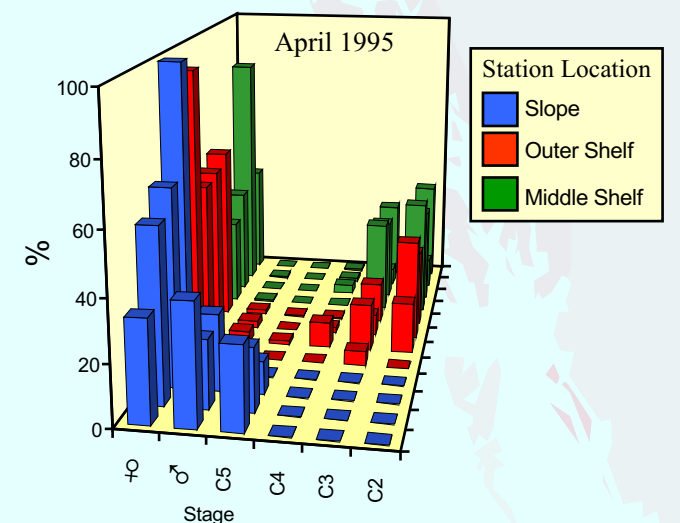


Figure 5. The stage composition of copepodites showed a progression from the Slope, where many late-stage copepodites had not yet molted to adults, to the Outer and Middle Shelf where numbers of C5 copepodites decreased markedly, and early stages constituted an increasing proportion of the population. These C2 and C3 copepodites represent a cohort that must have been produced before the Spring bloom and possibly under the ice.

Acknowledgments
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